

Novel Hybrid Bacterial Foraging and Spiral Dynamics Algorithms

A. N. K. Nasir¹, M. O. Tokhi², N. M. A. Ghani

Department of Automatic Control & Systems Engineering,
The University of Sheffield,
Sheffield, UK.

cop11ann@sheffield.ac.uk¹, o.tokhi@sheffield.ac.uk²

Abstract—This paper presents three novel hybrid optimization algorithms based on bacterial foraging and spiral dynamics algorithms and their application to modelling of flexible maneuvering systems. Hybrid bacteria-chemotaxis spiral-dynamics algorithm is a combination of chemotaxis strategy in bacterial foraging algorithm and linear adaptive spiral dynamics algorithm. Chemotactic behaviour of bacteria is a good strategy for fast exploration if large value of step size is defined in the motion. However, this results in oscillation in the search process and bacteria cannot reach optimum fitness accuracy in the final solution. On the contrary, spiral dynamics provides good exploitation strategy due to its dynamic step size. However, it suffers from getting trapped at local optima due to poor exploration in the diversification phase. Employing the chemotaxis and spiral dynamics strategies at the initial and final stages respectively will thus balance the exploration and exploitation. Hybrid spiral-bacterial foraging algorithm and hybrid chemotaxis-spiral algorithm, on the other hand are developed based on adaptation of spiral dynamics model into chemotaxis phase of bacterial foraging with the aim to guide bacteria movement globally. The proposed algorithms are used to optimize parameters of a linear parametric model of a flexible robot manipulator system. The performances of the proposed hybrid algorithms are presented in comparison to their predecessor algorithms in terms of fitness accuracy, time-domain and frequency-domain responses of the models. The results show that the proposed algorithms achieve better performance.

Keywords— *Hybrid algorithm; bacteria chemotaxis; spiral dynamics; system identification; flexible manipulator.*